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ART. IX.—*Some Fundamental Concepts in Victorian Physiography.*

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Introduction.

It may readily be gathered from the somewhat scant literature, that there is no general agreement among Victorian physiographers as to the nature of the chief factors that have combined to influence the topographic evolution of the State, more particularly the south-central portions, since the beginning of the Kainozoic Era. The extent to which the views of the workers

concerned diverge may be gathered from the following table, which presents in summarized form the main results achieved since 1903, when Gregory published his "Geography of Victoria."

TABLE I.

REFERENCE.	EROSION SURFACES.	AGE.
Gregory, 1903 ..	One peneplain, with the divide lying well to the north, in the Strathbogies and Mt. Buller	?
Skeats, 1910 ..	1. Ancient peneplain, represented in the summits of Mt. Macedon and the Dandenongs 2. Second peneplain, represented in the level of the country around Mt. Macedon	1. Pre-M. Kainozoic 2. ?
Jutson, 1911 ..	Nillumbik peneplain, including the Yarra Plateau and the Croydon Senkungsfeld	Post-Older Basalt, pre-Kalimnan
Keble, 1918 ..	Various erosion cycles are described, but apart from the old river valleys, erosion surfaces are not recognized	
Fenner, 1918 ..	"Great Peneplain." Level of the summit of the Blackwood and Brisbane Ranges; an extremely well-developed peneplain	Pre-Older Basalt, and called M. Tertiary
Summers, 1923 ..	Planation complete at the beginning of the Tertiary period. This again refers to the "Great Peneplain"	Early Tertiary
Fenner, 1925 ..	"Great Peneplain," destroyed in the Middle Tertiary	M. Tertiary
Baragwanath, 1925	1. Older peneplain, now at 4,500 feet-5,000 feet 2. Second peneplain, which is the pre-Older Basaltic erosion surface. Now at 3,000 feet-3,500 feet	1. Older than No. 2 2. Pre-Older Basaltic

Lack of a well-attested theory of historical physiography is particularly felt in teaching, and the present contribution aims at supplying, in so far as is at present possible, a basis for discussion and further advance. I have been over most of the country dealt with, in order to test the suggestions here put forward, and have been greatly helped by discussions with members of the staff of the Geology School at the University, Mr. F. A. Singleton, whose advice was especially welcome in connexion with Tertiary stratigraphy, and Mr. H. B. Hauser, in particular. The accurate relief model of the country around Port Phillip and Western Port Bays, constructed from the Military Survey Maps by Mr. H. B. Hauser and Mr. J. S. Mann, has proved of inestimable value.

PART I.

RECOGNITION OF EROSION SURFACES.

1. The Cretaceous Terrain.

It may be seen around the Dandenong Ranges that the land surface at the time of extrusion of the Older Basalts was of diversified relief, the resistant Devonian lavas rising above the general level of the surrounding country. With a topography such as this, the possibility exists that at the summits of the monadnocks of resistant rocks, we might find relics of the former land surface, which upon elevation and dissection gave rise to the later surface upon which the Older Basalts were poured out. Although such relics do not occur either at Mount Macedon or in the Dandenong Ranges, where the outcrops of resistant lavas are so small that the escarpments on the eastern and western sides of the lava outcrops have intersected to produce a ridge (see Fig. 1), the conditions are different further to the east. Here, the much larger outlier of Devonian lavas stretching from Warburton to Healesville, Marysville, the Cumberland

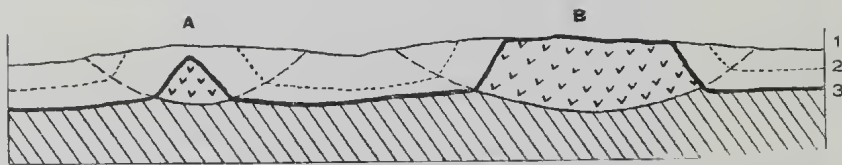


Fig. 1.—Diagrammatic section to show the evolution of a residual ridge (A) and of a plateau remnant (B). The old land surface is represented by the thin line 1, and there are two outliers of resistant lavas, a smaller at A and a larger at B. Upon uplift of the land, erosion of the soft bedrock begins, and escarpments develop at the junctions of the lavas and bedrock. An intermediate stage with two plateau remnants is shown by the broken line 2, and the existing topography, where A represents ridges such as the Macedon and Dandenong Ranges, and B dissected plateaus such as that around Donna Buang and northwards, is shown by the thick line 3.

Valley, and north to the Rubicon River, is so extensive that the summit still preserves, though no doubt in a somewhat modified form, a remnant of the old uplifted land surface. This mountain mass is to-day a dissected plateau, the summit of which ranges from about 5,000 feet at Mount Torbreck, down to 3,500 feet at Mount Strickland, near Marysville (see Hills, 1932, pp. 147-48). Therefore, the Devonian lavas must, at some period long antedating the extrusion of the Older Basalts, have been so reduced by erosion as to have formed part of a well-developed erosional plain, more complete than any which has since been developed in south-central Victoria.

Our estimate of the probable age of this erosional plain (whether it is to be termed "peneplain" or "panplain" will be, as yet, a matter of opinion), depends on the age assigned to the

Older Basalts. By the time these lavas were extruded, the old erosional plain had been uplifted and dissected to a late mature, or perhaps even old stage (see section on the pre-Older Basaltic Terrain), so it is clear that the uplift must have antedated the basalts by a very considerable period. Unfortunately, the evidence of age of basalts that do not come into relationships with marine Tertiary deposits is usually inconclusive, but it is now generally believed that the earliest flows were at least as old as Oligocene. If the basalts of the older deep leads are of this age, or even slightly younger, it is clear that the old erosional plain whose age is in question must have been uplifted either well down in the Eocene, or perhaps earlier still. The epi-Cretaceous movements which produced folding in Queensland may, in Victoria, have resulted in broad upwarping of the Upper Cretaceous land surface, and I would suggest that the ancient land surface preserved around Donna Buang, Marysville, and in the Cerbereans, is this uplifted Upper Cretaceous surface. Other probable remnants of this land surface, such as the Baw Baw Plateau, which was recognized by Baragwanath (1925) as representing a "peneplain" uplifted and dissected before Older Basaltic times, will be indicated below.

As we pass eastwards from the Melbourne district, the Older Basalt residuals become, in the Eastern Highlands, progressively more elevated. At the same time, the interfluves of the pre-Older Basaltic streams become continuously more eroded and reduced, so that we pass from a region where the Older Basalt may still occupy lower ground than the old interfluves (more especially than the old divides) to a region where the residuals now occupy the highest land, and where extensive relics of the monadnocks and interfluves of Older Basaltic times no longer exist. This explains why relics of the Cretaceous Terrain (see Glossary for terms used with a special significance) are more easily recognizable nearer Melbourne than in the Alps. The pre-Older Basaltic land surface has been differentially elevated, being tilted up to the east about an axis in the Melbourne district chiefly as a result of post-Kalimnan movements (q.v.).

2. The Pre-Older Basaltic Terrain.

It has for long been realized that, in the sub-Older Basaltic deep leads, we have preserved traces of an ancient river system, which has been discussed in detail by Keble (1918) and Baragwanath (1925). The land surface over which these rivers flowed is the "Great Peneplain" described by Fenner (1918, 1925), and by Summers (1923), the 3,000 feet–3,500 feet peneplain of Baragwanath (1925), and is probably the low level peneplain referred to by Skeats (1910) at Mount Macedon.

The evidence of the sub-Older Basaltic leads shows that over an extensive inland region, in the valley tracts of the rivers, the surface was maturely dissected, and towards the south, in the

plain tracts of the streams, there was much flat land. In the south, the basalts which further inland were confined within the stream courses, often spread out as sheets. Above these extensive regions at a mature or old stage of dissection, residuals of resistant Devonian lavas and "granite" rose.

3. The Pre-Older Basaltic Divide.

A. DISCUSSION OF GREGORY'S HYPOTHESIS.

Gregory (1903) has suggested that the main divide at this period was in the Strathbogies, and that from there streams ran south, over the present divide. Similarly, it is suggested (Keble, 1918) that a stream ran south from Mount Buller to join the well authenticated parent of the twin streams Thomson-Aberfeldy. The following considerations bear on this question:—

(i) *The Gorge of the Goulburn at Trawool.*—On Gregory's hypothesis the Goulburn has developed by headward erosion from an initial source west of the King Parrot Creek. At Trawool, the Goulburn has been superimposed upon a granite massif, through which, clearly over a protracted period of time, it has cut a gorge. It is difficult to find any reason why a stream so retarded should have been able to effect any significant extension of its headwater regions by headward erosion, a process which depends so completely upon the ability of a stream to rapidly degrade its course. Furthermore, it is difficult to see why, if the Goulburn in this district were not very early established as a master stream, it should not have been itself captured by a stream working round the south end of the Trawool granite.

(ii) *The Reversal of Former South-flowing Streams.*—Gregory's hypothesis also necessitates the postulate that the streams flowing south from the Strathbogies and Mount Buller, i.e., the streams now represented by the Upper Goulburn, Acheron, Yea, and King Parrot Creek, have been reversed, apparently by continually having their headwaters encroached upon by vigorously headwardly eroding streams of the developing Goulburn system. It must be pointed out that the Goulburn, as well as being handicapped by traversing the Trawool granite, would on Gregory's hypothesis be able to capture only a meagre amount of water from the supposed south-flowing streams, for it would have been necessary for it to have effected its development at the headwaters of those streams, near a presumably well-marked and mountainous divide. That it should have succeeded in reducing a mountain mass to a great valley, indeed to a river system, during post-Older Basaltic times is inconceivable, especially in view of the comparatively insignificant extent of post-Older Basaltic erosion on the Yarra Plateau, where in addition, the streams have been aided by post-Kalimnan uplift.

(iii) *The Yarra Plateau.*

(a) *Kangaroo Ground Residual.*—The Kangaroo Ground and adjacent residuals on the Yarra Plateau are some 900 feet lower than the divide at Kinglake. If the Kangaroo Ground pre-Older Basaltic stream had to pass over the divide on its way from the Strathbogies, this difference in elevation between two parts of its course so far from the headwaters is, assuming a normal thalweg, impossible. The conditions are better satisfied by assuming a pre-Older Basaltic divide not far from the present divide and only slightly higher.

(b) *Watson's Creek Residual.*—Watson's Creek and the creek to the south of it are twin streams, and the basalt residuals on the ridge between them are still at a lower level than the adjacent interfluves, which clearly represent the reduced pre-Older Basaltic interfluves. The Christmas Hills ridge, determined by a hard quartzite band (Jutson, 1911), is also higher than the residuals, and as shown by Keble and recognized by Jutson, must have been a divide between pre-Older Basaltic streams flowing west and east of this area. Followed to the north, the Christmas Hills merge into the Kinglake Plateau at the divide. It follows that the present divide itself, like the Christmas Hills, formed part of the pre-Older Basaltic Terrain.

(iv) *Conclusions.*—The above will have shown that it is impossible to place the pre-Older Basaltic divide as far north as the Strathbogies and Mt. Buller; that already in the pre-Older Basaltic times the Goulburn system was well developed, whether in its present form or not is immaterial; that therefore the pre-Older Basaltic divide approximated to the present divide.

(B) ALTERNATIVE HYPOTHESIS.

We may now consider the proposition that the pre-Older Basaltic divide was situated not far from the present divide, as an alternative hypothesis.

It has already been pointed out by Jutson (1911) and Keble (1918) that the Watts River, within the outcrop of the Devonian lavas, occupies an ancient course. This is the course initiated or rejuvenated on the break-up of the Cretaceous Terrain. The headwaters of the Acheron, by analogy, may be regarded as holding a similar inherited course. Donna Buang being the highest peak on the Warburton-Healesville Plateau, we may take it as marking the continuation of the old divide in this region. The Yarra at Warburton has clearly come to occupy a transverse course because of the case of erosion in an east-west direction as compared with that in a north-south direction, and during the course of erosion from the beginning of Tertiary time to the

present, has become a master stream because of this fact. At the present time the thalwegs of the Yea River and King Parrot Creek are at a much lower gradient than the streams flowing to the Yarra from the Kinglake Escarpment (see Fig. 2). This is due to the fact that the Goulburn, between its confluence with the King Parrot Creek and the Yea River, averages some 500 feet above sea level, while the Yarra is only 100 feet above the sea at its confluence with Diamond Creek. These gradients are the reverse of what would be expected on Gregory's hypothesis of stream development.

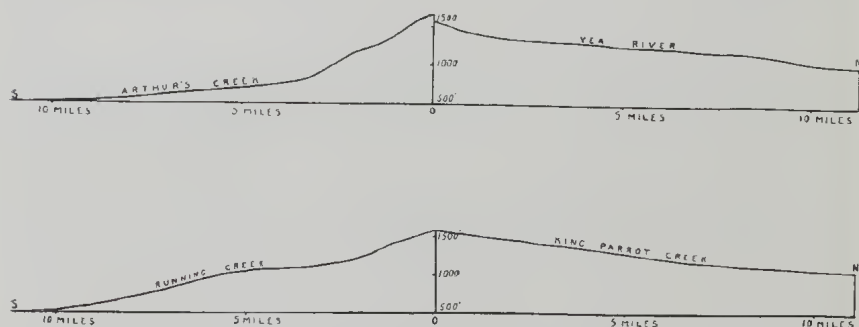


Fig. 2.—Stream profiles north and south of the divide. Data from Military Survey maps. Note the low gradient of the north-flowing streams. These erode relatively to the level of their confluence with the Goulburn, which is still some 500 feet above sea level. The irregular gradients of the south-flowing streams are probably due to the presence of hard bands in the Silurian rocks which they traverse, the effects of these hard bands being accentuated because of the steep gradient.

The Kinglake Plateau is a reduced pre-Older Basaltic land surface. Being at a divide, where rivers are stable in their courses for very long periods, this surface has been preserved, and merely reduced in level by gradual removal of soluble material from the soil, which is deep and rich, in contrast with the soils on the Silurian rocks of the Yarra Plateau, a younger land surface until recently undergoing active denudation. The actual divide is slowly migrating northwards, due to the steep gradient of the southern streams, the higher land at Mount Sugarloaf marking the probable position of the pre-Older Basaltic divide. The Older Basalt near Flowerdale on the King Parrot Creek is at a lower elevation than the divide at the head of the creek, and this clearly shows that the divide is an ancient feature. It is probable therefore that the Hume Plateau, which rises high above the present divide and above the basalt residuals, is a relic of the Cretaceous Terrain, and was a plateau remnant in pre-Older Basaltic times, as it is to-day.

(C) THE WERRIBEE GORGE AREA.

Fenner, in his papers (1918, 1925) on the Werribee River and Bacchus Marsh Basin, insists on the existence of only one peneplain, the Great Peneplain, which is the pre-Older Basaltic Terrain. This peneplain, now dissected, is the level surface exhibited by the upthrown blocks of the Blackwood Ranges and the Brisbane Ranges, and is the second peneplain of Skeats, above which Mount Macedon rises. I believe this view to be in great measure correct, but as will be pointed out later, if this is so our ideas of the nature of the Greendale and Spring Creek faults must be considerably revised.

4. The Nillumbik Peneplain.

This is defined by Jutson as including the Yarra Plateau of Gregory, together with the Croydon "Senkungsfeld." The peneplain was produced after the extrusion of the Older Basalts and before the deposition of the Barwonian and Kalimnan fluvial and shallow marine sands and gravels of the Melbourne district, which rest upon it.

In the Port Phillip region, immediately after or during the main Older Basaltic outbursts, depression of the land, leading to the marine incursions of the Barwonian, was initiated. This depression persisted until Kalimnan times, and during these periods it is clear that river erosion in the neighbouring districts must have been retarded. We may picture the streams distributing sand and gravel as flood-plain deposits in the lower parts of their courses, and, by lateral planation, producing local level erosion surfaces. It is clear, however, from the fact that Older Basalt residuals were left on the erosion surface, that no widespread erosional plain was produced. The Nillumbik Peneplain is best regarded as a modified pre-Older Basaltic Terrain, which, within the area prescribed, was of low relief. I propose, for reasons given below (see Peneplain, in the Glossary), to refer to it as the Nillumbik Terrain. It may be seen to-day as a stripped fossil plain, along the Mitcham-Tunstall axis, where the overlying Tertiary sands have been removed by erosion.

5. Post-Kalimnan Earth Movements.

We have no evidence that any major period of uplift, such, for instance, as might have raised the Eastern Highlands to their present elevation, took place between the extrusion of the Older Basalts and the end of Kalimnan times in Victoria. It is the post-Kalimnan movements which have determined the major topographic features of the State.

Evidence for a general Pliocene uplift antedating by some time the Newer Basalts is afforded by the uplifted marine Kalimnan sands of the Melbourne district. The fluviatile deposits which cap the hills in many parts of the Central Highlands were also uplifted before the Newer Basalts were erupted, and their physiographic relations are analogous to those of the Kalimnan sands around Melbourne, which themselves grade inland into fluviatile deposits. It is considered that the thick gravel deposits around Bairnsdale are Pliocene also, and these gravels, or a similar series, cap the hills as far inland as Buchan. It will be seen that there is good reason to place a general period of uplift somewhere between the Kalimnan (Lower Pliocene) and the earliest Newer Basalts. Before the basalts were erupted mature valleys were excavated in the uplifted land.

To turn to South Gippsland, the youngest deposits affected by the late Tertiary faulting are again the "Older Pliocene" fluviatile series. Here there is no doubt that the hills owe their elevation to post-Kalimnan movements, repercussions of which are still to be felt. In attempting to define a period of maximum late Tertiary uplift, it must be borne in mind that we are concerned with movements that can be shown to have been of wide geographical extent and of restricted time range. Locally, uplift or depression with minor oscillations has gone on throughout practically the whole of Tertiary time, as in the ancient Murray Gulf and at Sorrento. In addition, we once more come up against the difficulty that it is hard to fix the age of a series of subaerial lavas, the Newer Basalts. In the Western District, vulcanicity clearly continued into Pleistocene or Recent times, but the lava fields around Melbourne have been more deeply dissected, and appear to be slightly older. They were already extruded when swamp deposits containing *Diprotodon* were laid down, and a soil cover derived from the weathering of the basalts themselves is universal. If all the Newer Basalts are to be regarded as Pleistocene, those of the Melbourne district must belong to the earliest part of that period.

The period of maximum Pliocene uplift, then, as shown by all the evidence to date, was post-Lower Pliocene and pre-Pleistocene. Movements along the Rowsley and neighbouring faults of post-Newer Basaltic age seem to have been concerned chiefly with the depression of Port Phillip, and not with the uplift of the Highlands. There is no evidence anywhere in Victoria for a maximum uplift in the Pleistocene (Kosciusko Uplift), the elevation of the Highlands having taken place throughout Middle and Upper Pliocene times, culminating in the Upper Pliocene. In the Eastern Highlands it may prove to be the case that upwarp began earlier still near the divide, with concomitant downwarp in the Gippsland region.

PART II.

FAULT MOVEMENTS IN RELATION TO PHYSIOGRAPHIC EVOLUTION.

1. The Croydon Senkungsfeld.

In his paper on the Yarra, Jutson (1911) postulated a depressed area, bounded by faults—many of which are admittedly hypothetical—and named this area the Croydon Senkungsfeld. Keble (1918), however, presented an entirely different explanation of the topographic evolution of the district, unfortunately without any attempt to discuss Jutson's earlier work. The supposed fault scarps of the Brushy Creek and Yarra Faults are, it would appear, regarded by Keble as erosion escarpments, marking the position of an ancient watershed, the Wurunjerri Range, of which the Christmas Hills form part.

(i) BRUSHY CREEK AND YARRA FAULTS.

It is a remarkable coincidence that, as was clearly pointed out by Jutson himself (1911, *a*), the line of the supposed Brushy Creek and Yarra Faults should be faithfully followed, on the high level side, by a band of the most highly siliceous Silurian quartzite found by Jutson on the Yarra Plateau. As the strike of this hard band varies, so do the supposed faults change their course, striking east of north in the south, then west of north, and later east of north again. Jutson explains this by postulating a line of weakness along the hard beds, but there is no *a priori* reason to suppose that such actually existed. Jutson finds himself in difficulty when he traces these hard beds further north where they determine the Christmas Hills Spur. The same conditions hold—there is the hard band, the high land on the west, and the lower land on the east. But it is impossible to place a fault at the foot of the Christmas Hills, which are clearly (as was recognized by Gregory, Jutson, and Keble) a spur developed by differential erosion, jutting out from the Kinglake Plateau. Jutson therefore arbitrarily places a northern limit to the Yarra Fault movement, and marks a purely hypothetical fault running east-west across the spurs on the north side of the Yarra. As there is every reason to believe that the Christmas Hills owe their relative elevation to differential erosion, then stronger evidence than has yet been adduced is necessary to prove that the eastern boundary of the Yarra Plateau is not an erosion escarpment also, determined by the hard quartzite described by Jutson.

(ii) DANDENONGS FAULT.

On the eastern side of the Acheron valley, between Marysville and Taggerty, there are Upper Devonian lavas resting unconformably upon Silurian sediments, and the dissection of these,

as in the case of the rhyolites at Mount Wellington, has produced a well-defined escarpment parallel to the strike of the lavas. There is no reason to doubt that the escarpment at the edge of the Devonian lavas extending from Healesville round to Warburton is due to the same cause, for the boundary of the lavas and the Silurian, as mapped by Junner (1915) and Edwards (1932), is a natural one. The fault mapped by Jutson is non-existent. At the Dandenongs, remapping of the boundary of the Devonian lavas by Edwards, as shown in a MS. map kindly placed at my disposal, shows that the boundary faults marked by Morris Morris (1912) do not exist, the junction with the Silurian rocks being again a natural one. An escarpment at the edge of the hardest of the lavas is therefore to be expected as at Marysville and Healesville.

(iii) STEELE'S AND BRIATY'S HILLS.

These peaks on a north-south trending ridge of Silurian rocks (the Waranmate Hills) are marked by Jutson as being on the upthrown side of one of the boundary faults of the "Senkungsfeld." They are composed of silicified sandstones much more resistant than the average Silurian sediments of the district, and differential erosion is again sufficient, in my opinion, to explain their present elevation above the surrounding country.

I therefore maintain that there are no adequate grounds for regarding the basin of the middle Yarra and the Croydon Lowlands as a Senkungsfeld.

2. Alternative Hypothesis.

An alternative hypothesis must give an adequate explanation of (i) the course of the Yarra across the Yarra Plateau; (ii) the Yarra Flats; (iii) the general high level of the plateau as compared with the Croydon Lowlands; and (iv) the Yering Gorge.

(i) *The Course of the Yarra across the Yarra Plateau.*—Keble explains the present transverse course of the Yarra as being due to the capture of a stream formerly flowing south through Lilydale by the streams flowing west from the old divide of the Wurunjerri Range. Such a contingency is most improbable, firstly because of the extreme slowness of the migration of divides, and secondly because the conditions of the bedrock are such that, on Keble's hypothesis, the streams working in soft rocks are captured by those working in hard rocks (see section on the Yarra Plateau), and, moreover, are captured across a well-defined resistant ridge, the Wurunjerri Range.

I would suggest as a possible alternative that the diversion of the Yarra across the Wurunjerri Range was brought about by the blocking of the valley of the former north-south river flowing through Lilydale in pre-Older Basaltic times by ejectamenta from the Older Basalt vent recognized at Lilydale (Morris Morris, 1912). In pre-Older Basaltic times the edge of the Dandenongs escarpment would have been a little further west, the denudation of the toscanites would not have progressed to the extent seen to-day, and thus at Lilydale the valley of the pre-Older Basaltic stream must have been somewhat constricted. If blocked by lavas and tuffs, a lake would have been formed which would have found an outlet across a low part of the Wurunjerri Range, probably at the head of one of the tributaries of the stream flowing in the position of the Kangaroo Ground residual.

(ii) *The Yarra Flats*.—The level of the outlet so formed would act as a local base level of erosion, since composed of hard rock, and upstream from it the Yarra would meander and deposit extensive flats—the Yarra Flats. The level of these flats should be continually in a process of reduction if this hypothesis is true. We should find alluvium extending from the flats up among the higher hills around Lilydale, particularly in the valleys, into which long-continued rain action would wash most of the material. This is actually the case.

If the Flats are due to the exceedingly slow uplift of the Yarra Plateau, then they should never have been more extensive than they now are, and, further, since movement along the hypothetical Yarra Fault has presumably ceased, the Yarra should now be cutting away the Flats. This is not the case; the factor causing their development is still operative, and is to be sought in the presence of the hard rocks of the old Wurunjerri Range.

(iii) *The Yarra Plateau*.—The general high level of this region is due mainly to the resistant nature of the rocks of which it is composed. Quartzites, sandstones, and conglomerates occur there, and, in addition, the rocks have been indurated by the penetration of siliceous solutions, quartz veins being common in the mining districts. It was from various places on the Plateau and its southern extension in the Melbourne district that building stones were obtained in the early days of Melbourne's growth. East of the Plateau, especially to the south of the Yarra, the usual type of rock is a soft shale, often highly fossiliferous, any harder rocks being found as high land.

(iv) *The Yering Gorge*.—On the hypothesis here presented, this is to be explained as a part of the edge of the Yarra Plateau, isolated by having superimposed on it, from the older high level alluvium, a meander of the Yarra.

3. The Ballan Sunkland.

The data given by Fenner (1918) allow a reconstruction of the condition of the Ballan Sunkland immediately after the operation of the Greendale and Spring Creek Faults (see Figure 3). It is clear from this section that, if we are to regard the level of the Blackwood and Brisbane Ranges as representing the uplifted surface of the pre-Older Basaltic Terrain (Great Peneplain), then our interpretation of the geological history must be somewhat more complex than has usually been considered necessary.

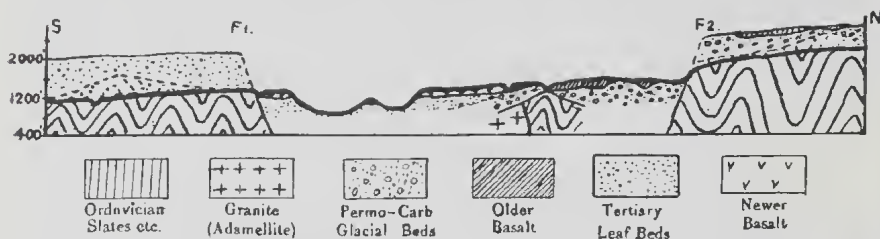


Fig. 3.—Section across the Ballan Sunkland. This section shows the sunkland as it was immediately after the operation of the Spring Creek Fault (F1) and the Greendale Fault (F2), according to data given by Fenner (1918). The existing topography is represented by the heavy line at about 1,200 feet in the south and over 2,000 feet in the north. The lower part of the section is from Fenner's Figure 13.

It will be clear that either the present level of the Blackwood Ranges (north of F2) is not that of the Great Peneplain (the pre-Older Basaltic surface), or that most of the movement along this fault had already occurred before the completion of the peneplain. If the Brisbane Ranges are regarded as part of the peneplain, then either they are a stripped and slightly dissected fossil plain, from which the Tertiary sands have been removed, or else the sands occupy a basin initiated by movements along the Spring Creek line.

The possibilities are as follows:—

(a) If the Spring Creek Fault is correctly drawn, then the Brisbane Ranges are a "stripped fossil plain," from which the overlying Tertiary sands have been washed, not so much by normal stream erosion, but as "mud may be washed from a board" (an expression recently used, as a quotation, by Fenner in another connexion). The great ease of erosion of these beds makes this quite a feasible idea.

(b) The Spring Creek fault may be regarded as a line of post-Older Basaltic sag, initiating a basin which was filled by the lignitiferous sands of the Parwan Basin and Lal Lal district. The sands on this hypothesis never covered the Brisbane Ranges.

(c) The preservation of so much Permocarboneferous tillite on the downthrown side of the Greendale Fault is a very strong indication that most of the movement along this line went on during the formation of the Great Peneplain, or earlier still, for

the upthrown side has suffered about 1,000 feet of reduction since the major movement went on. If the Blackwood Ranges represent the Great Peneplain surface, the erosion must have been 'pre-Older Basaltic. Later movement of small amount has probably gone on.

4. The Mansfield District.

In his paper on this area, Fenner (1914) discusses the evolution of the rivers, and concludes that the drainage has been directly affected by what he clearly regards as Tertiary block faulting, although the age of the faults is not unequivocally stated, and no stratigraphical evidence for their existence was obtained. As a result of a visit to the Mansfield and neighbouring districts in 1928, I was able to supply the missing stratigraphical evidence of block faulting, which is of fundamental

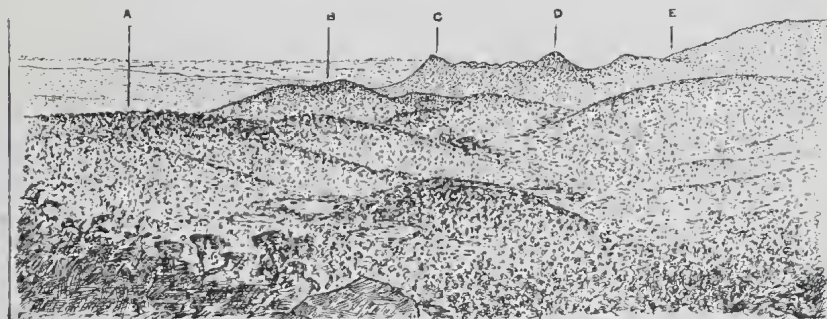


Fig 4.—View from Keppel's Lookout, Marysville, looking north. This view over the timbered valleys of the Taggerty and Steavenson Rivers illustrates the importance of subsequent stream dissection. The Lookout is situated on the top of the escarpment bounding the Devonian lavas, and the continuation of the escarpment to the north is seen at (E). The lavas at (E) probably once covered the hard Silurian sandstones of the Cathedral Range (C-D), which pass beneath the Devonian at the saddle between the Sugarloaf (D) and the escarpment (E). The curve of the talus slope from the Cathedral (C), a massive sandstone dipping to the east, is well shown. At Buxton, an intrusion of garnetiferous grandodiorite porphyrite forms the hill (B) to the east of the village. Between Buxton and Marysville the rocks are Silurian sediments, and the topography is determined by differences in hardness among these beds. The ridge (A) leading up to Mount Gordon is composed of hard sandstones.

importance for an understanding of the geology of the region, but could find no evidence that the movements are of Tertiary age. The scarps are all fault line scarps, and the presence of quartz veins along certain of the fault lines, as on the western side of Mount Timbertop, is a good indication that the faults are much older than Tertiary, more probably Upper Palaeozoic. One of the faults postulated by Fenner is, he thinks, connected with the uplift of the Cerberceans, but, as has already been shown,

these mountains are a relic of the Cretaceous Terrain, and their steep edge is the escarpment at the edge of the Upper Devonian lavas of which they are in part composed (Hills, 1932). In the absence of more definite evidence to the contrary, therefore, I would suggest that the development of the complex middle course of the Goulburn has been controlled, not by Tertiary faulting, but by subsequent (differential) dissection of a region of complex geology.

5. Conclusion.

The above remarks are not intended to minimize the importance of Tertiary faulting as a physiographic control in Victoria. In Gippsland, particularly, the evidence for extensive late Tertiary faulting is conclusive and illuminating, but in the Eastern Highlands such is not the case, and no undoubted Tertiary fault has yet been identified. My own reference (1932) to the "tilted blocks of a broken peneplain," occurring west of the Black Hills. Taggerty, is incorrect. The supposed tilted blocks are a series of strike ridges. Indeed, a preconceived idea of the dominance of block faulting in this region for long prevented the author from realizing what is actually the chief topographic control over extensive areas, and that is, geological structure, etched out by the long continued attack of erosive agents.

6. Glossary and Summary.

A. SYSTEMATIC TERMS.

1. *Terrain*.—The land surface at any specified time within the region under consideration. It is sometimes preferable to use this term instead of "erosion surface," since it includes erosion surfaces of all ages represented in the topography.

2. *Inherited*.—A term used to describe physiographic entities such as stream courses or summit levels, the former condition of which has left a very marked impress upon the existing feature.

3. *Peneplain*.—The errors that may be introduced by a loose application of this term to all moderately flat (often, too, only locally flat) erosion surfaces are very great. Wherever preliminary investigations only are made without detailed study, it is preferable to use a term such as "Terrain," without the genetic significance attached to the word "peneplain."

4. *Plateau Remnant*.—A small plateau or table mountain, representing a relic of a former land surface of low relief, uplifted and dissected in a new cycle of erosion.

B. REGIONAL TERMS.

1. *Cretaceous Terrain*.—The land surface, of uniformly low relief, before the major late-Cretaceous uplift. Remnants now to be seen are (a) the Cerbereans—Donna Buang Plateau; (b) the Hume Plateau; (c) the Trawool Plateau; (d) Baw Baw Plateau.

2. *Pre-Older Basaltic Terrain*.—This is the "Great Peneplain" of Fenner. It is the land surface produced by erosion between the late-Cretaceous uplift and the earliest Older Basalts. The plateau remnants of the Cretaceous Terrain described above were monadnocks on the pre-Older Basaltic surface, but large areas, especially in the Palaeozoic sediments, were of low relief. Remnants now to be seen are (a) the Kinglake Plateau—representing the modified pre-Older Basaltic divide; (b) the Christmas Hills; (c) the Brisbane Ranges (in part); (d) the Blackwood Ranges (in part); (e) the sub-Older Basaltic leads.

3. *Nillumbik "Peneplain"*.—This is the land surface produced during post-Older Basaltic and pre-Kalimnan times in the Yarra Plateau and Croydon Lowlands. It is a modified pre-Older Basaltic surface, and may now be seen as a stripped fossil plain, along the Mitcham Axis.

4. *Hume Plateau*.—The Hume "Ranges" are really a plateau, whose summit ranges from 2,200 feet to 2,500 feet.

5. *Trawool Plateau*.—The granitic country south of Trawool is a plateau, more deeply dissected than the Hume Plateau because nearer the Goulburn, but with a summit at much the same elevation.

6. *Kinglake Escarpment*.—See Kinglake Plateau.

7. *Kinglake Plateau*.—The present divide from Kinglake West to above Kinglake is a narrow plateau trending roughly east-west, at an elevation of 1,600-1,800 feet. This is bounded on the south by a steep erosion escarpment, for which I propose the term Kinglake Escarpment. The plateau bears deep and rich soils, which extend down in places on to the tops of the main spurs that run off from it to north and south, and which are, like the Plateau, ancient topographic features.

8. *Yarra Plateau*.—This comprises the country from the Christmas Hills to the Plenty River, and from Kinglake Escarpment to the divide on the Mitcham Axis. It is composed mainly of relatively hard and resistant Silurian sediments. (Gregory, 1903; Jutson, 1911).

9. *Croydon Lowlands*.—Since I believe that the term "Senkungsfeld," as applied to the Croydon district, implies an erroneous conception of the history of the area, I propose the name Croydon Lowlands for the country between the Yarra Plateau and the Dandenongs, south of Lilydale.

10. *Brushy Creek and Christmas Hills Escarpments*.—The scarps of the supposed Brushy Creek and Yarra Faults are, I believe, erosion escarpments. The scarp of the so-called Yarra Fault, continued to the north, is seen to form part of the Christmas Hills Escarpment.

11. *Wurunjerri Range*.—A pre-Older Basaltic divide, represented to-day by the Christmas Hills, and the eastern edge of the Yarra Plateau (Keble, 1918).

12. *Mitcham Axis*.—A line, possibly a post-Kalimnan warp axis, from Burt's Hill through "Pinemont" and Blackburn to Camberwell (Jutson, 1911).

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